Research Article

Effect of Nutrition Intervention Using a General Nutrition Course for Promoting Fruit and Vegetable Consumption among College Students

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ABSTRACT

Objective: To evaluate the effectiveness of implementing nutrition intervention using a general nutrition class to promote consumption of fruits and vegetables in college students.

Design: 3-day food records were collected, verified, and analyzed before and after the intervention.

Setting: A midwestern university.

Participants: 80 college students, ages 18 to 24, participated in the study.

Intervention: The intervention focused on nutrition knowledge related to prevention of chronic diseases, healthful dietary choices increasing fruit and vegetable consumption, dietary feedback, and interactive hands-on activities.

Main Outcome Measures: Consumption of: total vegetable, fresh vegetable, starchy vegetable, french fries, vegetable juice, total fruit, fresh fruit, canned fruit, and fruit juice.

Analysis: Dependent t test was used to analyze the differences in pre- and posttest. Analysis of variance was used to determine differences in dietary changes between groups.

Results: Participants significantly increased consumption of not only total fruits and vegetables ($P < .005$), but also fresh fruits and vegetables ($P < .005$). Intake of french fries decreased significantly ($P < .05$). Females responded better to the intervention than males in increasing vegetable consumption ($P < .05$).

Conclusions and Implications: Class-based nutrition intervention focusing on prevention of chronic diseases is a cost-effective approach to increasing fruit and vegetable consumption among college students.

Key Words: college students, fruit, vegetable, nutrition class, nutrition intervention (J Nutr Educ Behav. 2009;41:103-109.)

INTRODUCTION

The college years are a period of significant change in the lifestyles of young adults. Food patterns established during college are likely to be maintained for life and may have long-lasting influences on college students’ future health and the health of their future families. Furthermore, an inadequate diet during the college years could result in unfavorable physiological consequences that could lead to diet-related chronic diseases. The dietary patterns of college students should be a concern to health professionals. It is well documented that college students have unhealthful eating behaviors, including skipping meals, frequent snacking on energy-dense food, and engaging in unhealthful weight-loss methods. In addition, dietary intakes of college students appear to be high in fat, saturated fat, cholesterol, and sodium, whereas they are low in fiber; vitamins A, C, and E; folate; iron; and calcium. An extensive body of research reveals that a diet high in fruits and vegetables is associated with a reduced risk of cancer and heart disease and may aid in weight management. Fruit and vegetable consumption in college students is between 2.1 and 5.5 servings, which is below the current recommendation of 9 servings or $4\frac{1}{2}$ cups. Furthermore, college students have less awareness than older adults of the health benefits of fruits and vegetables and the effects of poor dietary practices.

Although numerous nutrition education programs promote fruit and vegetable consumption, relatively few efforts have targeted college students in these nutrition interventions. Traditionally, the most successful programs for diet modifications have involved individual contact with a registered dietitian or other primary health care provider. However, these methods may not fit with the busy lifestyles and unpredictable schedules of most college students, causing potential for high attrition. Recently, alternative cost-effective interventions have been introduced to specifically target college students. For example, newsletters were used to promote fruit and vegetable intake in college students, and their participation in this intervention was found to increase fruit and vegetable intake by 1 serving.

Investigators
in this study combined newsletters with a motivational interview and e-mail follow-up to increase the intervention’s impact on dietary behavior change. Shive and Morris also found that a social marketing campaign improved fruit consumption among college students by offering a fruit fair on campus that included distribution of fruit samples and brochures.26

Similarly, college nutrition courses have been used to enhance nutritional knowledge in college students with the goal to encourage dietary change.27,28 However, results of these investigations indicate that this type of intervention appears to be successful only in increasing nutrition knowledge and not in changing dietary intake. In contrast, Matvienko et al reported that participation in a college nutrition science course prevented weight gain in freshmen, suggesting that class-based nutrition education may help college students translate nutrition knowledge into dietary changes.29

Overall, prior research on interventions targeting college students’ dietary behaviors suggests a need to develop curricula targeting specific nutrition behaviors in college students.

The purpose of this study was two-fold: (1) to assess the current intake of fruits and vegetables in a sample of college students; and (2) to evaluate the effectiveness of participation in a 15-week basic nutrition class in increasing consumption of fruits and vegetables in college students. The present intervention is unique in combining the use of conventional education materials with interactive feedback and “hands-on” activities in promotion of increased fruit and vegetable intake.

METHODS

During the spring of 2006, 90 healthy college students between the ages of 19 and 35 years who were enrolled in a basic sophomore-level nutrition class at a midwestern university participated in the study. Among them, 10 participants were excluded from the final analysis. Exclusions included students who were older than 25 years, preexisting medical conditions limiting dietary intake (ie, celiac disease), illnesses affecting food intake during the data collection period (ie, flu), or incomplete or unreliable data. The study population consisted of undergraduate students from various majors including Nutrition and Dietetics (35%), Human Development (28%), other (30%) (ie, Hospitality Management, Audiology, Exercise Science), and undeclared (7%) majors. Participants were told that the purpose of the study was to obtain data to develop a nutrition education intervention program for college students. This research was approved by the Kent State University Institutional Review Board, and informed consent was obtained from each participant before enrollment in the project.

A pretest–posttest design was used to assess effectiveness of nutrition education on changes in vegetable and fruit consumption of college students. Data were collected during the first 2 weeks and the last week of spring semester 2006. At the time of both pre- and post-testing, a 50-minute interview was conducted with each participant to gather anthropometric data, as well as to verify completion and accuracy of each participant’s food record. Body weight was measured in kilograms to the nearest ± 0.1 kg using an electronic scale (Body Fat Monitor/Scale [TBF 551], Tanita, Arlington Heights, IL), with the student in light clothing and without shoes. Standing height without shoes was recorded on a portable stadiometer (The Portable Adult/Infant Measuring Unit [PE-AIM-101], Perspective Enterprises, Kalamazoo, MI) to the nearest ± 0.1 cm with mandible plane parallel to the floor. Each subject’s body mass index (BMI) was calculated as weight/height$^2$ (kg/m$^2$).

Dietary intake was assessed using 3-day dietary records. Subjects were instructed to record their food intake over 2 weekdays and 1 weekend day while adhering to their usual eating practices. They were told to avoid days with special events or exam days for reporting dietary intake. A variety of tools and procedures was used to obtain reliable data:

1. Food models, measuring cups and spoons, household utensils, and tableware were used to illustrate proper portion sizes.
2. Participants were asked to collect and bring all the food labels of the products they consumed during the data collection period.
3. To obtain the most accurate information about ingredients and portion sizes, research associates visited the local restaurants and campus cafeterias where a majority of the participants ate.
4. Food items were also purchased by the researchers to estimate portion sizes when students were not able to provide accurate information.

Dietary analyses were performed by the trained researcher using Nutri-Base IV Clinical software (Cyber Soft, Inc., Phoenix, AZ, 2002).

Fruit and vegetable intake was reported in cups so results could be compared to the MyPyramid food guidance system.23 The guidelines provided by the Centers for Disease Control and Prevention are based on daily calorie needs estimated by considering age, gender, and activity level.90 These guidelines are given in cups of fruits and vegetables.

The class met 3 times a week for 50 minutes per session over a 15-week period. To minimize the effect of class materials on eating behavior and physical activity patterns, lectures during the baseline data collection focused on topics not directly related to dietary intake and health, such as “How the Body Uses Food,” “Food Insecurity,” and “Food Safety.”

Class lectures covered topics that addressed overall dietary quality, including: (1) the importance of nutrition related to prevention of chronic diseases; (2) increasing consumption of fruits, vegetables, and whole-grain products; (3) encouraging low-fat dairy product consumption; (4) discouraging over-reliance on dietary supplements; and (5) promoting an active lifestyle. In addition to the traditional approach of lectures, videotape watching and various class activities were introduced. The present educational investigation is unique because of its combination of conventional education materials and “hands-on” activities that were goal oriented. By focusing not only on increasing academic knowledge, educational materials and activities that were goal oriented, reinforced, and focused on students’ current environment and social constructs were developed.31 Many of the activities and class lectures were tied to the Social Cognitive Theory (SCT), whereby
students were using their own dietary behaviors and lifestyle choices as a framework to learn course materials. Table 1 lists course activities, as well as the constructs from the SCT that each activity meets. The SCT is based on interaction of environment (ie, factors that affect a person’s behavior), personal factors (cognitive, affective, and biological events), and behaviors that an individual performs. This theory is typically used in health education and behavior programs and can be used as a framework for developing intervention strategies. SCT has been successfully used in previous interventions to increase fruit and vegetable consumption. 

Statistical Analysis
Means and standard deviations were calculated for all the variables analyzed. The statistical program and procedures of SPSS for Windows (version 14.0, SPSS, Inc., Chicago, Ill, 2005) were used for all analyses. Consumption variables for the current investigation included the following: total vegetable, fresh vegetable, starchy vegetable, french fries, vegetable juice, total fruit, fresh fruit, canned fruit, and fruit juice. Pre–post differences were assessed using analysis of variance (ANOVA). Differences in consumption were not significantly different according to gender, residency, and years in college; therefore, data were pooled and paired t tests determined overall differences in fruit and vegetable variables. Significance was set a priori at $P \leq 0.05$.

RESULTS
Eighty students enrolled in a sophomore level general nutrition course participated in this investigation. Average BMI of the participants was $26.3 \pm 5.6 \text{ kg/m}^2$. Average age of the participants was $20.2 \pm 1.4$ years. The majority of the participants were female (88%). The residence status of the participants was: 16% lived at
home, 40% lived in the dorm, 35% lived off campus, and 6% reported another living arrangement.

Pre- and posttest means and standard deviations are reported in Table 2. Since no differences in fruit and vegetable consumption between genders (P = .13 and P = .83, respectively), place of residence (P = .49 and P = .49, respectively), and years in college (P = .27, P = .79, respectively) were found between pre- and posttest measures, the data were pooled (ie, all participants included). Paired t tests revealed overall differences in fruit and vegetable consumption from pre- to posttest regardless of grouping variables (ie, gender, residency, year in school). Statistically significant increases in consumption of total vegetable, fresh vegetable, total fruit, and fresh fruit were demonstrated between pre- and posttest measures (Table 2). A significant decrease in french fry consumption was also noted between pre- and posttest measures (P = .01). Fruit and vegetable consumption data at posttest between males and females did show a significant difference in vegetable consumption (P = .036) at posttest whereby females consumed more vegetables than males. No differences (P = .806) in fruit consumption at posttest were demonstrated.

Overall, vegetable consumption and fresh vegetable consumption were low at the beginning of the study. Seventy-two percent of participants consumed 1 cup or less of total vegetables, and 90% of participants consumed 1 cup or less of fresh vegetables at the onset of the investigation. Both total vegetable and fresh vegetable consumption increased by the end of the investigation. Sixty-five percent of the participants were consuming more than 1 cup of vegetables, and over 50% of the participants were consuming more than 1 cup of fresh vegetables by the conclusion of the class. The consumption of starchy vegetables did not change from pre- to posttest (P = .47).

Overall, students participating in this study demonstrated an increase in fruit consumption (Table 2). Ninety-two percent of participants consumed 2 cups or less of fruit per day. By the conclusion of the semester, 22% of the participants were consuming more than 2 cups of fruit per day. Increases in fresh fruit consumption were also shown whereby at the time of the pretest, 90% of participants were consuming 1 cup or less of fresh fruit, but at posttest, 39% of participants were consuming greater than 1 cup of fresh fruit per day. There was only a 10% decrease in fruit juice consumption over the semester, which was found to be nonsignificant between pre- and posttest measures (P = .147). No change in the consumption of canned fruit was demonstrated (P = .473).

### DISCUSSION

The present investigation assessed the intake of fruits and vegetables of college-age students and examined the effectiveness of a 15-week intervention in fruit and vegetable consumption as part of a general nutrition course. Numerous researchers have reported that college students display unhealthful eating patterns and are engaged in unsound dieting practices. The typical diet of college students is often low in fruits and vegetables and high in fat, simple sugar, and sodium content. This type of diet can be characterized by a lack of certain vitamins and minerals and fiber.

The present study confirmed that college students do not consume fruits and vegetables at the recommended dietary intake. This research also found that exposure to a class-based nutrition education intervention driven by SCT for 18- to 24-year-old college students may help this age group meet the recommended servings of fruits and vegetables (ie, 4.5 cups for women and 5 cups for men). This finding is important because increasing fruit and vegetable consumption would increase intake of dietary fiber, folate, and vitamins A and C, all of which are known to be lacking in the typical diet of college students. Furthermore, research literature that has shown that increases in nutrition knowledge or general nutrition knowledge does not necessarily predict dietary change. The present investigation resulted in statistically significant increases in the intake of both fruits and vegetables. This finding is consistent with previous research that showed positive changes in dietary behaviors after nutrition education interventions with college students.

Limited research exists on nutrition education interventions promoting fruit and vegetable consumption by college students. Mitchell reported that basic nutrition classes changed college students' food choices but failed to show increases in fruit and vegetable consumption. More recently, Richards et al demonstrated that use of stage-based newsletters in college students increased fruit and vegetable consumption by 1 serving a day, which is equivalent to a 0.5-cup increase and is similar to the results in the current investigation that nutrition education increased the consumption of fruits and vegetables. However, the magnitude of increase in fruit and vegetable intake observed in this study was much higher. A general nutrition course may be more effective in increasing consumption because students are more frequently exposed to education materials.

### Table 2. Pre- and Posttest Variable Means ± Standard Deviations for Vegetable And Fruit Consumption

<table>
<thead>
<tr>
<th>Consumption (cups per day)</th>
<th>Pretest</th>
<th>Posttest</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>0.77 ± 0.62</td>
<td>1.52 ± 1.03</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Fresh vegetables</td>
<td>0.46 ± 0.50</td>
<td>1.20 ± 0.93</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Starchy vegetables</td>
<td>0.30 ± 0.33</td>
<td>0.29 ± 0.40</td>
<td>.47</td>
</tr>
<tr>
<td>French fries</td>
<td>0.15 ± 0.28</td>
<td>0.07 ± 0.15</td>
<td>.01</td>
</tr>
<tr>
<td>Vegetable juice</td>
<td>0.01 ± 0.07</td>
<td>0.02 ± 0.15</td>
<td>.75</td>
</tr>
<tr>
<td>Fruit</td>
<td>0.94 ± 0.92</td>
<td>1.33 ± 0.89</td>
<td>.002</td>
</tr>
<tr>
<td>Fresh fruit</td>
<td>0.43 ± 0.61</td>
<td>0.99 ± 0.85</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Canned fruit</td>
<td>0.06 ± 0.15</td>
<td>0.05 ± 0.15</td>
<td>.473</td>
</tr>
<tr>
<td>Fruit juice</td>
<td>0.45 ± 0.64</td>
<td>0.32 ± 0.47</td>
<td>.107</td>
</tr>
</tbody>
</table>
At the beginning of the investigation, participants’ consumption of both fruits and vegetables did not meet the recommended intake. Consumption of both fruits and vegetables by the current study’s participants was lower than the intake by college students participating in similar studies. \[22,37\] These differences may be owing to varying methodologies such as method and timing of data collection. At the conclusion of the intervention, however, participants consumed 2.85 cups of fruits and vegetables, which is less than current recommendation in MyPyramid of 4 1/2 cups a day, but this finding demonstrated an improvement over baseline intake. \[38\] Furthermore, the number of servings of vegetables more than doubled, indicating the current intervention may have had a greater effect on increasing vegetable intake than increasing fruit intake. This result is inconsistent with other research showing more of an increase in fruit intake than vegetable consumption \[19\] or similar increases in both fruits and vegetables. \[20\] This inconsistency may be because fruit intake at baseline was closer to the recommended dietary intake and vegetable intake was below the recommended servings. Although increases in fruit consumption were smaller compared to the increases in vegetable intake, it is notable that fresh fruit intake significantly increased, whereas fruit juice consumption remained the same.

In the current study, fruit and vegetable consumption at baseline or between pre- and posttest did not differ between genders. Other researchers have found that females consume more servings of fruits and vegetables than males, \[37,40\] indicating the result of the current investigation might be specific to this study population or because males’ caloric intake is higher, inadvertently explaining their consumption of vegetables to be higher. Another possible explanation is that the number of males in this study was not large enough to result in a statistically significant difference. Furthermore, males enrolled in the basic nutrition course may already be more interested in and practice healthful eating compared to typical male students. However, posttest results showed that vegetable consumption by female students was higher than that of their male counterparts, implying that female students may be more receptive than male students to interventions focused on increasing vegetable consumption. The difference in fruit and vegetable consumption patterns at the conclusion of the study is not surprising in light of previous research. Several researchers have demonstrated that females hold a more positive attitude toward healthful eating and fruit consumption, more social pressure to consume fruit, and are more health conscious than their male counterparts. \[41,42\] This result suggests that future nutrition education interventions require effective and specific tools focused on motivating male students to increase fruit and vegetable consumption.

The results of this research also indicated that, both at baseline and after the intervention, housing status did not appear to influence fruit and vegetable consumption. Chung et al found that students living on campus ate more fruits and vegetables. \[21\] One possible explanation for the inconsistent findings with Chung et al is that dining rooms for dorm residents on campus for this study population were open to nonresidents as well, which provided the same food choices opportunities for both residents and nonresidents. In addition, this investigation found that fruit and vegetable intake did not differ according to years in college. This is not a surprising result, because all students are exposed to the same environment that affects their food intake, such as busy schedules both for work and class, limited funds, and lack of cooking facilities and skills.

There are several reasons why a promising outcome was seen in this particular study population. Throughout the semester, during lectures, class activities, and projects, the importance of fruit and vegetable consumption was addressed as well as its association with health-related topics (ie, cardiovascular diseases, cancer, diabetes, obesity, osteoporosis, and hypertension). Lectures were also expanded to discuss mechanisms by which diet can prevent the development of certain chronic diseases. This knowledge may have been especially interesting to the students, since more than half of the students in class had more than 1 family member suffering from at least 1 chronic disease, which might be an intrinsic factor to motivate students to change their eating habits. In addition, class lectures not only encouraged students to increase fruit and vegetable consumption, but also motivated them to change overall eating behavior and their lifestyle by using a variety of class activities and assignments. Examples include: introducing simple recipes of fruits and vegetables; assigning home cooking; tasting healthful snacks, and writing a healthful activity log; providing tips for healthful eating when dining out; and using the guiding principles of SCT. These activities and assignments provided students with opportunities throughout the course to assess their personal behaviors and environmental factors that affected those behaviors. Two key learning opportunities were dietary record analysis and goal setting. This approach may have helped students relate the class material more directly to their own dietary habits, thereby giving them more awareness and motivation to change their own dietary behaviors. Another factor may be that the class met more frequently (ie, 3 times a week) than traditional nutrition education intervention programs of only once a week. This finding is supported by research reporting that when the frequency of meeting was greater, dietary changes were higher. \[43\] Finally, students received their baseline dietary analysis as feedback during the first month of the class and used it to compare their intake with recommended servings for each food group and nutrient recommendation covered during lectures. This activity helped students recognize their nutrient intakes in high and low values and identify food sources, which in turn motivated them to be engaged in overall healthful eating, which included increasing fruit and vegetable consumption.

Overall, this research showed the possibility that using a class-based nutrition education intervention in a general nutrition course may be an effective approach that has the potential to change eating behaviors with minimum additional manpower and financial resources in a college setting. Incorporation of messages to the students to increase fruit and vegetable consumption blended well with current general nutrition course material. It allowed for class learning to move
from knowledge to application. To further strengthen the goal of the class to increase fruit and vegetable consumption, additional “hands-on” projects (Table 1) grounded in SCT allowed for students to use the knowledge that they gained in class and use it toward understanding their own dietary behaviors. The class projects not only made the students aware of their dietary habits, but it also created opportunities to address weaknesses in their diets, which then increased awareness and need for dietary modification. Class activities in turn may have had a positive impact on students’ breadth of knowledge gained in the course and may as well have provided a forum necessary to create a behavior change.

This study has several limitations. A convenience sample rather than a random sample was used. As a result, the study population may not represent traditional college students through oversampling of females and nutrition and dietetics students. In addition, a control group was not used to control for possible confounding factors such as seasonal variation in intake. Students who were already more interested in healthful eating may be more likely to choose to take a nutrition course. Long-term effect of the intervention over time was not included in the study design. Future research should be directed toward longitudinal studies to examine long-term effect of class-based nutrition education on changes in dietary behavior.

A major strength of the present study is that this study was focused on obtaining accurate dietary data using various methods (ie, interviewing campus cafeteria managers; purchasing actual food from local restaurants; having participants to bring food labels, utensils, and cups used most at home; and having only one nutritionist analyze the dietary record).

IMPLICATIONS FOR RESEARCH AND PRACTICE

In conclusion, class-based nutrition education intervention focused on prevention of chronic diseases has potential to increase fruit and vegetable consumption among college students. Furthermore, effectiveness of class-based nutrition education in increasing fruit and vegetable consumption among college students regardless of their major, housing status, gender, and year in college was demonstrated. Using a class-based nutrition education intervention in a general nutrition course may be an effective approach that has the potential to change eating behaviors with minimum manpower and financial resources in a college setting.

Male students responded differently to this nutrition education intervention, indicting future research should focus on gender-tailored nutrition intervention.

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